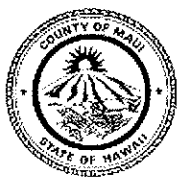
Wellhead Protection Strategy for Maui County

Molokai Chapter
DRAFT



County of Maui Department of Water Supply

ACRONYMS

AST	Above ground storage tank
BMP	Best Management Practice
CERCLA	Comprehensive Environmental Response, Compensation, And Liability Act
CWA	Clean Water Act
CWRM	Commission on Water Resource Management
DWS	Department of Water Supply
DOH	Department of Health
EPA	U.S. Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
HAR	Hawaii Administrative Rules
HISWAP	Hawaii Source Water Assessment Program
HRS	Hawaii Revised Statues
NPDES	National Pollution Discharge Elimination System
PCA	Potential Contamination Activity
PUD	Planned Unit Development
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SDWB	Safe Drinking Water Branch
SHWB	Solid and Hazardous Waste Branch
SUP	Special Use Permit
SWAP	Source Water Assessment Program
TSRA	Toxic Substances Control Act
UIC	Underground Injection Control
USGS	United States Geological Survey
UST	Underground storage tank
WHPA	Wellhead Protection Area

EXECUTIVE SUMMARY:

The Maui County Department of Water Supply (DWS) is working with landowners and other stakeholders to develop a wellhead protection program for Maui County. The project goal is to create effective wellhead protection in the form of a local ordinance to prevent increased risk from potential contaminating activities (PCAs) and reduce risk of contamination in drinking water wells. Future protection efforts will be based upon DWS data analysis and field surveys of wellhead protection areas contained within this report. The project analysis also attempts to incorporate the completed State Source Water Assessment Program (SWAP) and the State Wellhead Protection Program. A draft strategy plan and ordinance has been developed in consultation with an advisory committee for the Island of Maui. A report documenting the inventory of PCAs on Molokai and a brief analysis thereof was prepared and presented to the Molokai Water Advisory Committee in October of 2008 and February of 2009. This report is an update that adds suggested protection strategies for identified PCAs. Private purveyors, including Department of Hawaiian Homelands, Kawela Plantation and Molokai Ranch have been invited to participate in the project.

In summary, the Wellhead Protection Project consists of the following tasks:

1. Delineation of Wellhead Protection Areas (WHPAs). Land areas that could contribute water and pollutants to the water supply are mapped by University of Hawaii Water Resources Research Center as part of the Hawaii Source Water Assessment Program (HISWAP). WHPAs delineated by Horsley & Witten in a 1992 demonstration wellhead protection project are also included.

2. A documentation review of various wellhead protection strategies undertaken by utilities, counties, cities, districts and state agencies in the U.S. The research included the collection of 59 references and the preparation of an annotated bibliography. Programs and ordinances are reviewed and annotated, followed by a survey to help evaluate the efficiency of each program.

3. An inventory of land uses and potential contaminating activities in WHPAs. Current, future and historic land uses, facility type, nature of activities and site specific information is documented and mapped in GIS.

4. An inventory of contaminants typically associated with identified PCAs. Potential and confirmed contaminants are documented in databases, including descriptions of the environmental transport characteristics (how contaminants move) and toxicity.

5. Identification of best management practices (BMPs) for pollution prevention of identified PCAs, including checklists for public education.

6. A review of the land use control structure and ground water protection programs in effect in Maui County.

7. Develop a wellhead protection strategy for Maui County that incorporates input from advisory committees representing each island community. The Water Advisory Committees on Maui, Moloka'i and Lana'i have voiced support for an overlay zoning ordinance. DWS continues to solicit public input and participation throughout development of the Wellhead Protection Program.

AQUIFERS & WELL SITES

In 1994, The U.S. Environmental Protection Agency (EPA) designated Molokai as an island wide sole source aquifer- (an aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer). The Department wells delineated on maps and GPSd in this project are drawing water from the Ualapue, Kawela and Kualapuu aquifers. The aquifers are considered fresh (<250 mg/l Cl-), irreplaceable and classified as "high sensitivity". Aquifer sensitivity is defined by the EPA as "the relative ease with which a contaminant applied on or near the land surface can migrate to the aquifer of interest". It is determined by the intrinsic characteristics of the geologic materials of the aquifer. Aquifers in Hawaii are described by Mink and Lau (Mink and Lau 1992: "Aquifer Identification and Classification for Molokai: groundwater protection strategy for Hawaii", Technical Report No. 187) as either vulnerable or not vulnerable to contamination, based on geographical limits of the resources, confining conditions and the relatively rapid time of groundwater travel. When combined with factors of land use and contaminant characteristics, the aquifer's vulnerability to contamination can be further evaluated. Well information was gathered from State databases and from visual survey of the well sites and described in Table 1. The table includes the Waikalae Tunnel which is a groundwater source under the influence of surface water. Well site and surroundings and well information for inventoried wells are documented in Figure 1.

Table 1 – DWS Molokai Wells Delineated in SWAP

Well Number	Well Name	Yr Drill_ed	Well Type	Casi_ng Dia	Ground Elev	Well Depth	Solid Case	Perf Case	Use	Use Yr	Init Water	Init Chl	Pump GPM	Spec Capac
0449-01	Ualapue Shaft	1936	DUG	48	40	43			MUN	47	4.1	64	0	1500
0457-01	Kawela Shaft	1921	SHF	48	36	39			MUN	72	1.9	16	300	
0801-03	Kualapuu Mauka	1987	PER	14	1037	1136	1027	1077	MUN	94	11.7		1000	93
1059-01	Waikalae Tunnel		TUN		1780				MUN				0	

Figure 1 – Well Information

WELL NAME	Ualapue Shaft
WELL NUMBER	0449-01
USE	Drinking water
AQUIFER SYSTEM	Ualapue
AQUIFER HYDROLOGY	Basal : Fresh water in contact with seawater
AQUIFER TYPE:	Unconfined
GEOLOGY:	Flank: horizontally extensive lavas
AQUIFER USE STATUS:	Currently used
AQUIFER UTILITY:	Drinking
AQUIFER SALINITY:	Fresh (<250 mg/l)
AQUIFER UNIQUENESS:	Irreplaceable
AQUIFER VULNERABILITY:	High

Upslope of Kawela Shaft

WELL NAME	Kawela Shaft
WELL NUMBER	0801-03
USE	Drinking water
AQUIFER SYSTEM	Kawela
AQUIFER HYDROLOGY	Basal : Fresh water in contact with seawater
AQUIFER TYPE:	Unconfined
GEOLOGY:	Sedimentary, nonvolcanic lithology
AQUIFER USE STATUS:	Currently used
AQUIFER UTILITY:	Drinking
AQUIFER SALINITY:	Fresh (<250 mg/l)
AQUIFER UNIQUENESS:	Irreplaceable
AQUIFER VULNERABILITY:	High

WELL NAME	Kualapuu Mauka
WELL NUMBER	0457-01
USE	Drinking water
AQUIFER SYSTEM	Kualapuu
AQUIFER HYDROLOGY	High level : Fresh water not in contact with seawater
AQUIFER TYPE:	Unconfined
GEOLOGY:	Perched, aquifer on impermeable layer
AQUIFER USE STATUS:	Currently used
AQUIFER UTILITY:	Drinking
AQUIFER SALINITY:	Fresh (<250 mg/l)
AQUIFER UNIQUENESS:	Irreplaceable
AQUIFER VULNERABILITY:	High

WELL NAME	Waikalae Tunnel
ID	1059-01
USE	Drinking water
AQUIFER SYSTEM	Kualapuu
AQUIFER HYDROLOGY	High level : Fresh water not in contact with seawater
AQUIFER TYPE:	Unconfined
GEOLOGY:	Perched, aquifer on impermeable layer
AQUIFER USE STATUS:	Currently used
AQUIFER UTILITY:	Drinking
AQUIFER SALINITY:	Fresh (<250 mg/l)
AQUIFER UNIQUENESS:	Irreplaceable
AQUIFER VULNERABILITY:	High

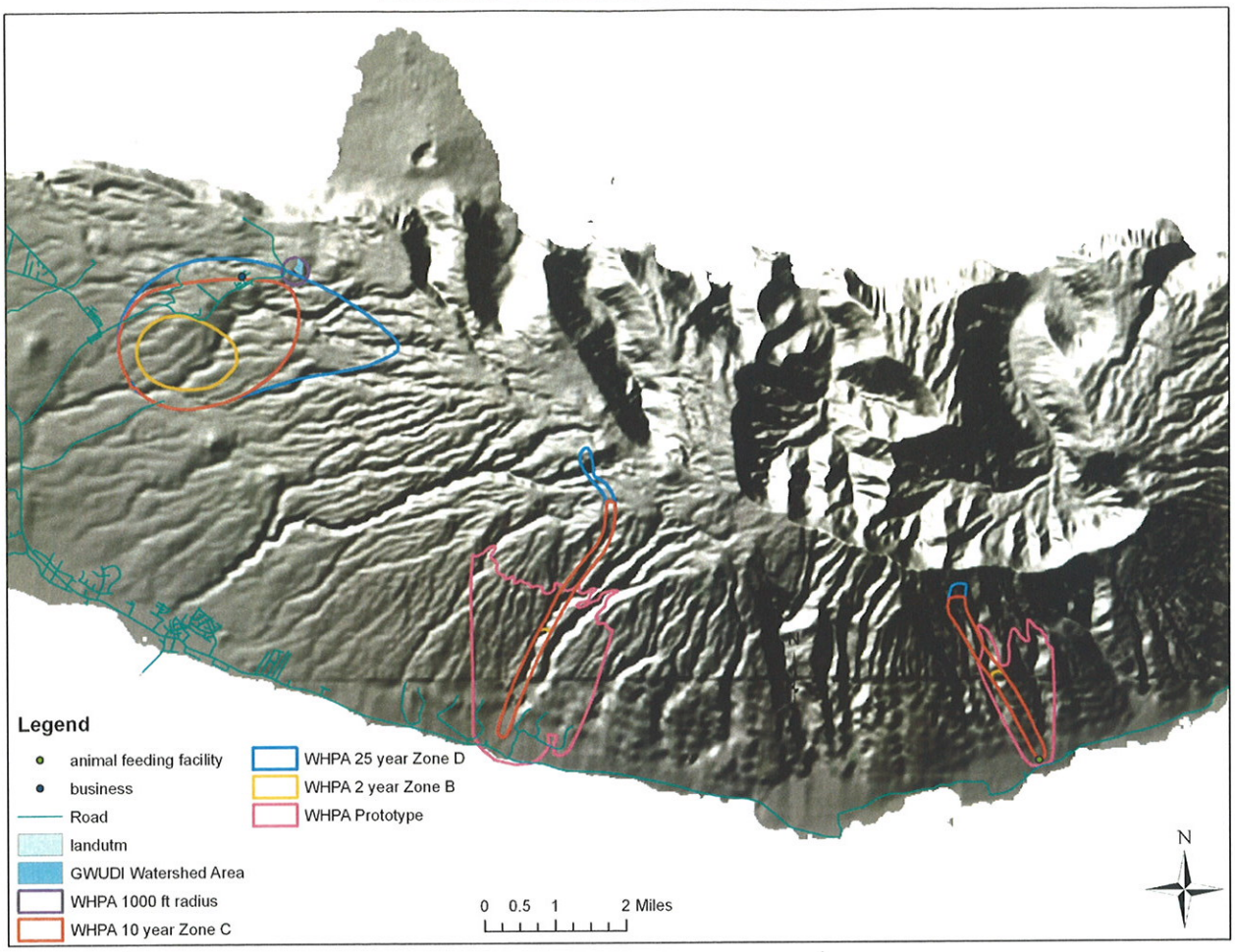
WELLHEAD PROTECTION AREA MODELING

A Wellhead Protection Area (WHPA) is defined by the 1986 Amendments to the Safe Drinking Water Act as "the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield," or in other words, the area from which pollutants are likely to contaminate well water. Horsley & Witten delineated WHPAs in a 1992 demonstration wellhead protection project, using an EPA WHPA Code and General Particle Tracking Module (GPTRAC) groundwater model. 12 private and public wells were included in this project, and capture zones were plotted for 25 years. These WHPAs are referred to as prototype WHPAs. Prototype WHPAs were delineated for a cluster of wells at Kawela and Kualapuu, including private wells. Smaller pie-shaped portions of the WHPA contribute to each DWS well. In 2004, WHPAs for Department wells on Molokai were delineated by University of Hawaii Water Resources Research Center for the State SWAP. The SWAP modeling uses MODFLOW, a three-dimensional numerical groundwater model, and MODPATH, a particle tracking program. The WHPAs delineated for Molokai include a 2-year (Zone B), 10-year (Zone C), and 25-year (Zone D) time of travel. The SWAP designates a 50 foot fixed radius around each well to provide protection from direct contamination (Zone A). DWS added a 1,000 foot fixed radius to account for existing regulatory setback from wells for certain PCAs. The 2-year time of travel zone is intended to designate a conservative estimate of the surrounding area which may contribute bacteria and viruses to the wellhead, based on typical survival times for bacteria and viruses in soil and groundwater (HISWAP Second Draft, 1998). The 10-year and higher time of travel zones would allow protective measures in the event of a contaminant spill. Any land use management in this zone needs to address hazardous and persistent contaminants. Bacterial and viral risks may also be a concern.

Waikalae tunnel is classified as ground water under direct influence (GWUDI), where there is a hydraulic connection between surface water and the tunnel. The WHPA for Waikalae tunnel is delineated using a combination of ground and surface water approaches. Zone A is the 50 foot radius around the source, Zone B is the 1,000 foot radius, and Zone C is the entire watershed area upstream from the source.

MODFLOW is a well documented model that allows new sources to be added to the model fairly easily. Figure 2 illustrates MODFLOW WHPAs based on 2-, 10- and 25-year time of travel, GWUDI delineations and the prototype 25-year time of travel WHPAs delineated by Horsley & Witten.

Figure 2 – Wellhead Protection Areas



POTENTIAL CONTAMINATING ACTIVITES INVENTORY

Land uses considered PCAs are those facilities that typically use, produce, or store contaminants of concern, which, if managed improperly, could find their way to a drinking water source. The inventory of PCAs in delineated areas overlapped with SWAP, which was completed by the State Department of Health, as mandated by the Safe Drinking Water Act in 2004. The assessment included delineation of the area around a drinking water source through which contaminants may travel to the drinking water supply; an inventory of PCAs, determination of the susceptibility of the drinking water source to become contaminated from the surrounding PCAs; and public disclosure and access to the information. Since the SWAP was completed by the time of DWS field survey of Molokai, the field survey relied upon records gathered in the SWAP. DWS added more site specific data. Historic agricultural lands were identified from agricultural land use maps drafted 1978-80s. Activities to be inventoried were selected referencing SWAP. Appendix A lists PCAs, categorized as Agricultural, Commercial – Industrial, Municipal or Residential.

Contaminants of concern are chemicals and other material that can leach and contaminate groundwater sources. Chemicals associated with PCAs were identified as those that might be expected to be detected at delineated wells, including those regulated under State Drinking Water Standards and referencing standards lists compiled by the U.S EPA and the State DOH. Chemicals regulated under the Safe Drinking Water Act and the Hawaii drinking water rules, and those on the

EPA Drinking Water Contaminant List are listed in Appendix B.

In March 2005 staff performed field surveys of Department well sites and accessible portions of WHPAs to verify PCA locations and to identify any additional PCAs. Mapped PCAs and general historic land use are illustrated in Figures 3 thru 8. An update to the PCA inventory was completed in March 2010.

Ualapue Shaft
The well site is located in grassy kiawe brush. A spill site and a piggery are within the 2-year time of travel zone and the 1000 ft radius. Within the 25-year prototype WHPA there are 24 residences and a school. A cesspool is possibly within the 1000 ft radius or just makai. A private well was being drilled at approximately 200 feet distance at the time of the survey update in March 2010.

Kawela Shaft
The well site is in a grassy and wooded area. A spill site is within the 2-year time of travel zone. Within the prototype WHPA there are multiple residences and a former nursery. An intermittent stream flows within 220 feet of the well and could function as a conduit for stream borne contaminants.

Kualapuu Well
Former pineapple cultivation extends into the 2-year time of travel zone. Del Monte operations established at Kualapuu in 1927 were phased out in the 1970s and 80s. A previous diesel spill in the WHPA has been remediated.

Waikalae Tunnel
The source is currently not in use. Obvious PCAs are feral animals and associated bacterial contaminants.

Figure 3 – Potential Contaminating Activities Ualapue Well

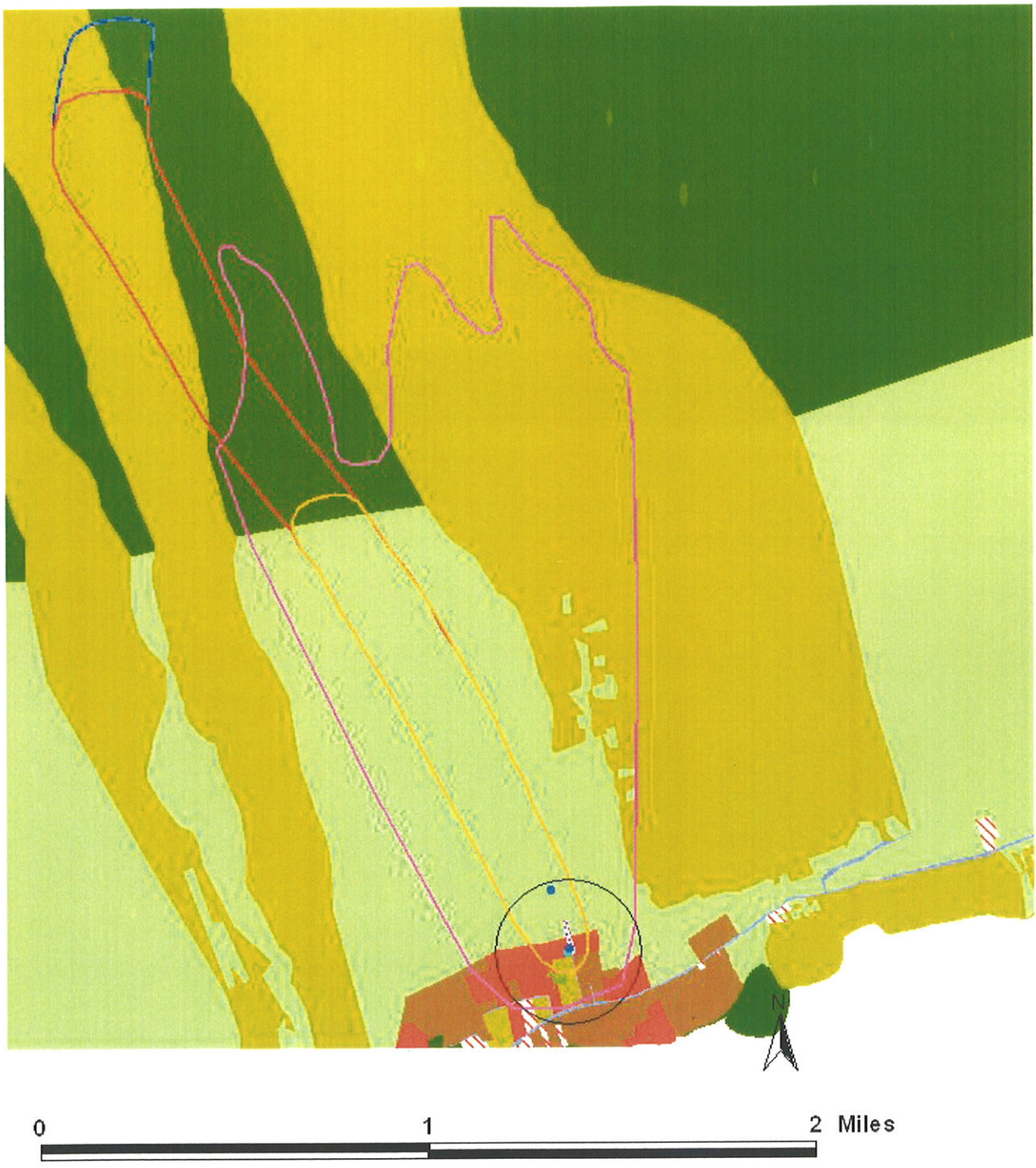


Figure 4 – Historic Land Use Ualapue Well

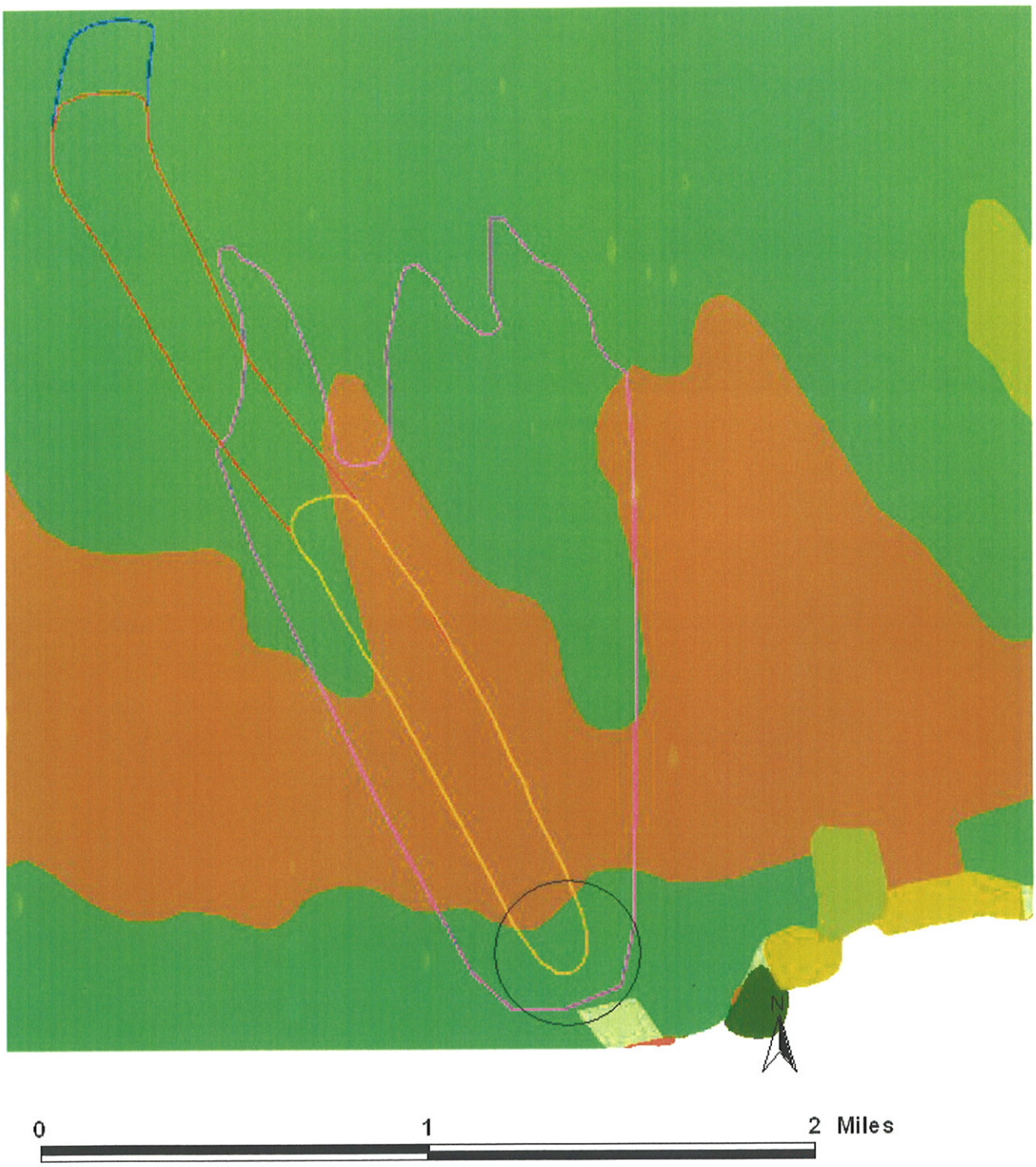


Figure 5 – Potential Contaminating Activities Kawela Well

Figure 6 – Historic Land Use Kawela Well

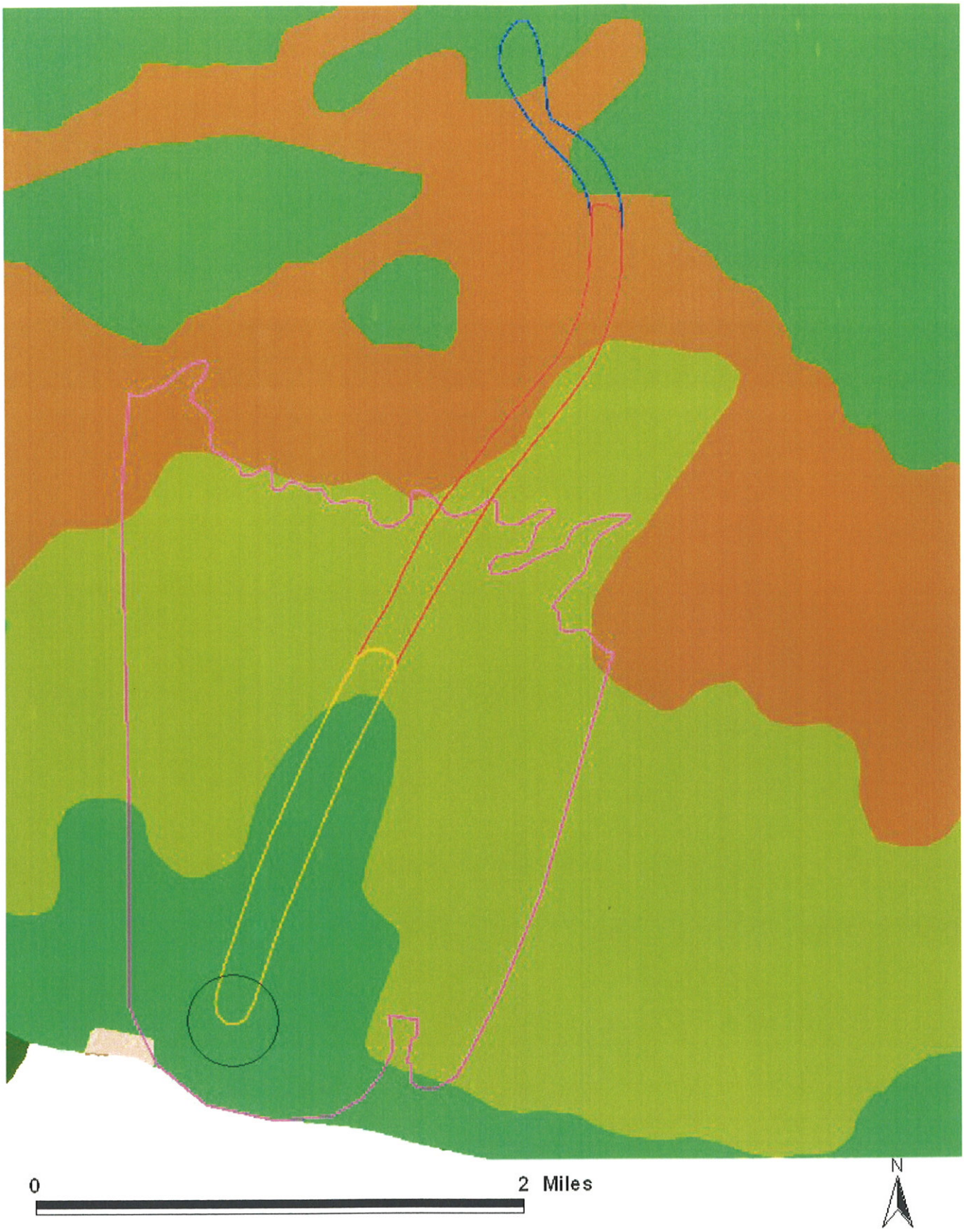


Figure 7 – Potential Contaminating Activities Kualapuu Well

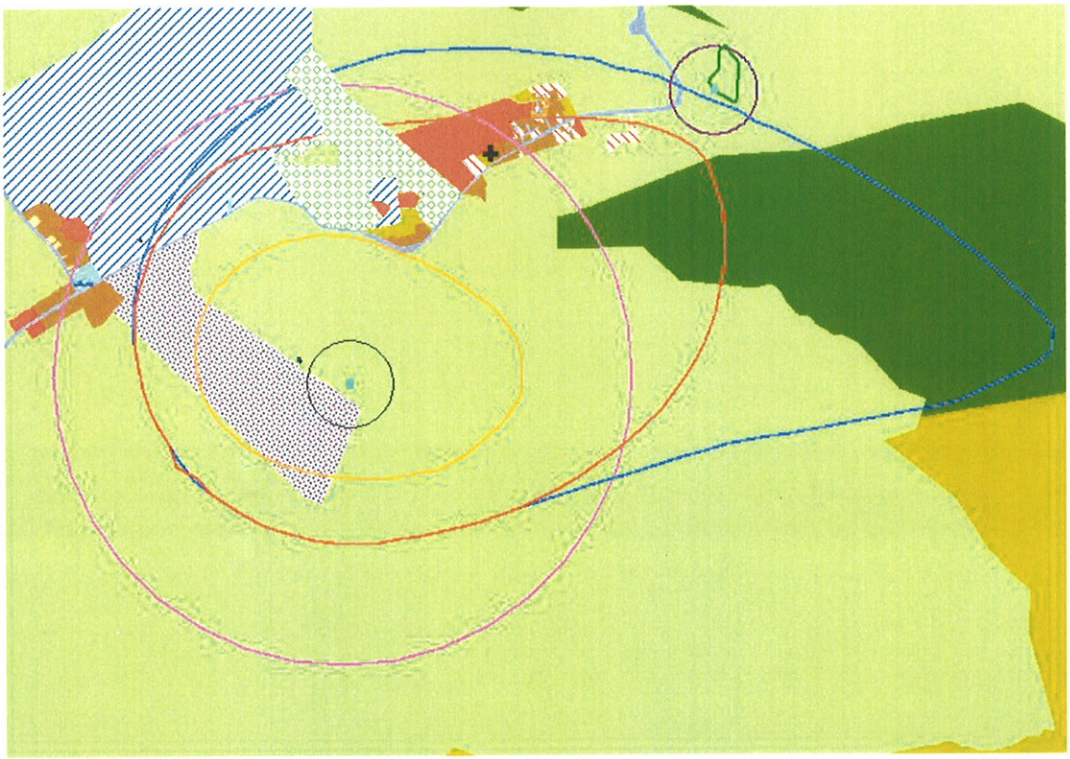


Figure 8 – Historic Land Use Kualapuu Well

Figure 9 – Legend

LAND USE CHANGES

Molokai remains rural and agricultural in character. Significant portions of the WHPAs are located on land within the Conservation district. Development within the WHPAs is curtailed by the Commission on Water Resource Management (CWRM) designation of a Ground Water Management Area. The designation resulted from community involvement and the fact that groundwater uses were determined to exceed 90 percent of Molokai aquifers' sustainable yield. The 2000 Molokai Community Plan's environmental goals seek to "protect both the groundwater recharge areas above the 2,000 foot elevation and the wellhead protection areas from contamination as identified on the Community Plan Land Use Maps." No implementing action directly follows the objective, but could be addressed through protection measures suggested in this document. Land development must be consistent with the State Land Use Districts, the Community Plan and County zoning designations. The State Land Use districts are shown in Figure 10. The Community Plan designations are depicted in Figure 11.

Figure 10 – State Land Use Districts

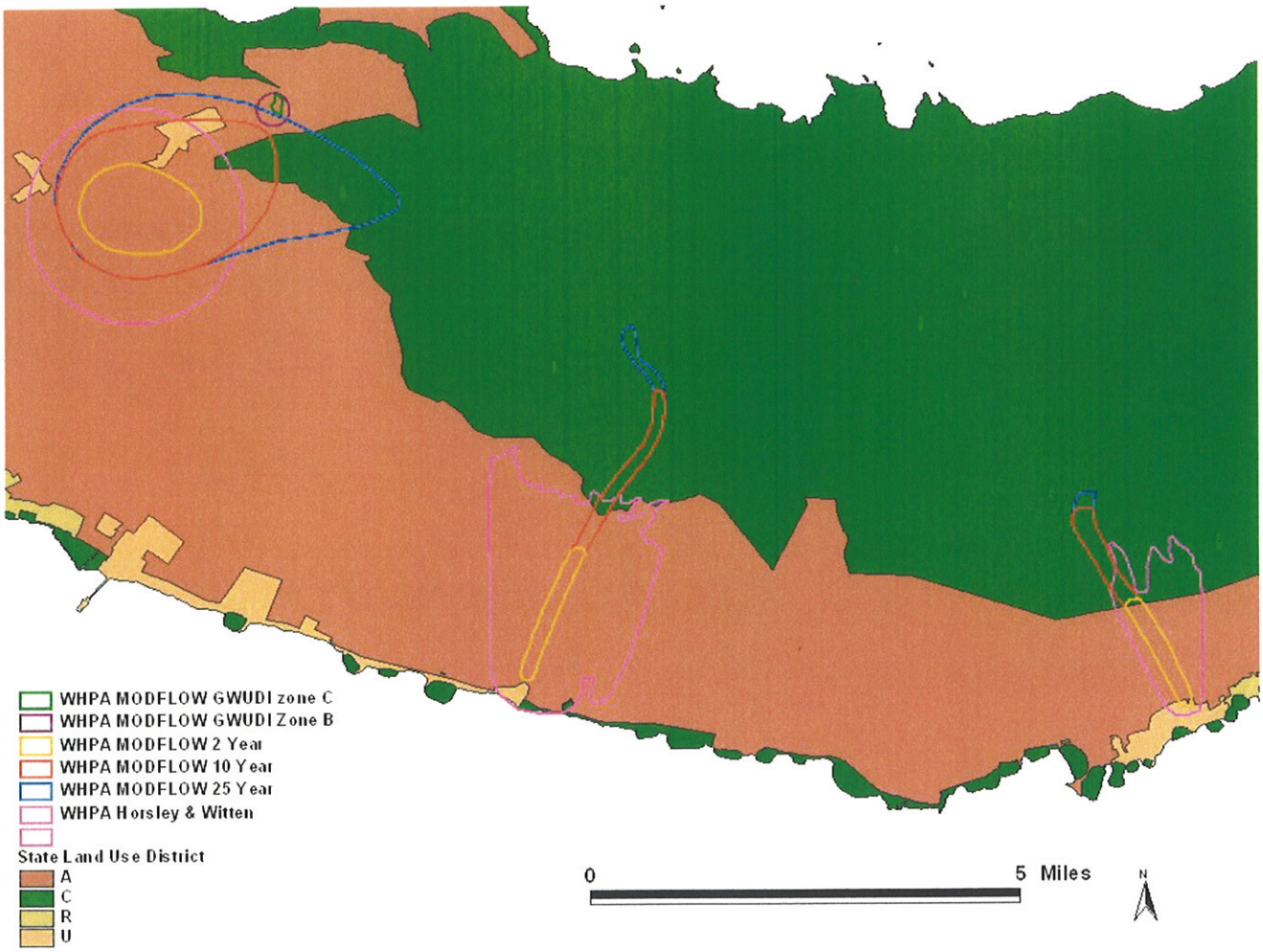
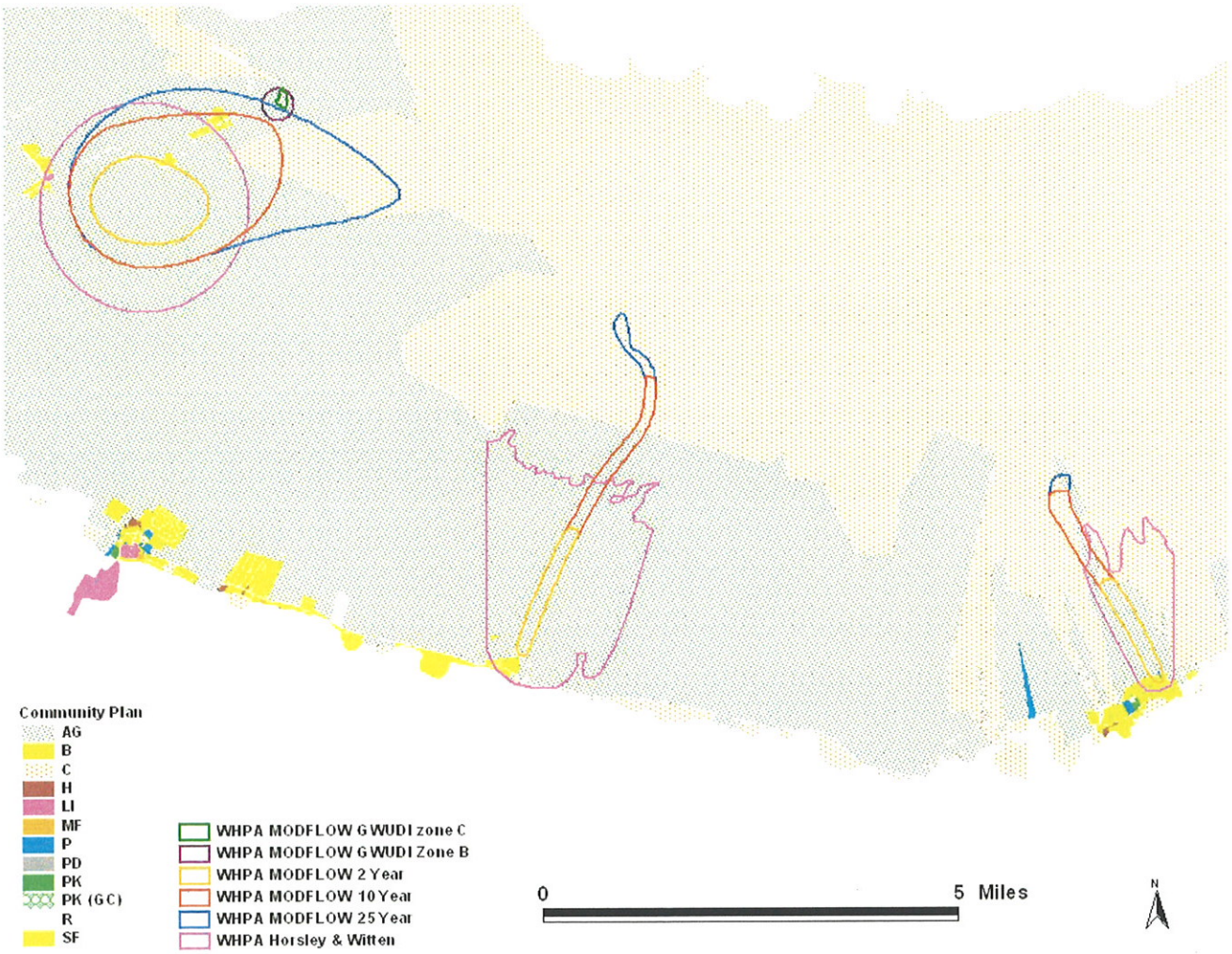


Figure 11 – Community Plan Districts



SUSCEPTIBILITY

SWAP conducted a susceptibility analysis, defined by EPA guidance as "the potential for a Public Water System to draw water contaminated by inventoried PCAs at concentrations that pose concern." Susceptibility takes into account both site specific geologic/hydrogeologic factors (aquifer type) and characteristics of the PCA (e.g., nature of the activity, contaminants found in the well, distance from source, areal extent). The SWAP analysis incorporated five criteria in order to rank the potential of each PCA to adversely impact the water quality of each well:

1. Type of PCA: SWAP established PCA categories based on their potential to contaminate a drinking water source. A PCA was defined as very high, high, or medium risk based on specific characteristics of the PCA, namely, the nature of the activities, contaminants associated with the activities, and past history of contamination.
2. The distance of the PCA from the source: the closer a PCA is to the well, the higher the likelihood that a contaminant released would adversely impact the well.
3. The area occupied by the PCA: in general, the larger the spatial area that is impacted, the higher the potential for contamination. For PCAs such as cesspools, residential parcels, septic systems, sewer lines and parks, the scoring was assigned by the density.

4. Detection of potential contaminants commonly associated with PCA at the source: past detection demonstrates definite contamination risk. Scores were given on whether a contaminants is detected at concentrations above the MCL, detected at concentrations below the MCL (or has no MCL), not detected, or detection is unknown because contaminant is not monitored.
5. Aquifer sensitivity: The vulnerability of the geologic/hydrogeologic setting was discussed under the section "Aquifers and Well Sites". The aquifer sensitivity was rated as high, moderate and low. High sensitivity is characterized by basal and high level aquifers that are unconfined and may include aquifer types that are flank, dike, sedimentary, or a combination.
A numerical scoring system was used to relatively rank the susceptibility of the drinking water source to each PCA. The general concept is that the higher the score, the higher the potential for contamination from that particular PCA. (Hawaii Source Water Assessment Program Report Volume I, Approach Used For the Hawaii Source Water Assessments. November 2006). The SWAP analysis results are provided in Table 2.

Table 2– Susceptibility Analysis for DWS Wells

Well	**Ualapue Well**					**Kawela Well**					**Kualapuu Mauka**				
PCA Count/ Zone	A	B	C	D	PCA SCORE	A	B	C	D	PCA SCORE	A	B	C	D	PCA SCORE
Spill site	1	1			10x3 = 30 10x2 = 20	1	1			10x3 = 30 10x2 = 20		1		1	10x2 = 20 10x0.5 = 5
Hog farm	1	1			10x3 = 30 10x2 = 20								1		10x1 = 10
AST						1				3x3 = 9	1	1			3x3 = 9 3x2 = 6
Pineapple fields												63 ha	38 ha	<10	15x2 = 30 12x1 = 12 6x0.5 = 3
Cesspools													95	45	15x1 = 15 10x0.5 = 5
Golf course													1	1	6x1 = 6 6x0.5 = 3
Septic system													4	4	4x1 = 4 3x0.5 = 1.5
DAG RCRA													1		1x1 = 1
Residential houses													99	49	3x1 = 3 2x0.5 = 1
TOTAL PCA SCORE:					**100**					**59**					**134.5**

Additional data is available that could expand the matrix and provide more site-specific information, such as well depth and age, contaminant characteristics, soil type and rainfall. Potential health effects of exposure through drinking water to contaminants were also researched during the Maui data inventory. The purpose of the analysis indicate where source protection may be most needed and what PCAs should be targeted.

PROTECTION STRATEGIES

Inventoried PCAs may in fact pose no or very little concern because of regulations and best management practices already in place. The regulatory framework of ground water protection was

reviewed in the Maui project process. State legislation and federal mandates provide for groundwater protection through land use and natural resource planning and programs specifically dealing with groundwater protection. A table of programs in place is provided as Appendix C. PCAs are administered by a range of state, federal and county regulations. A table of legislation of PCAs reviewed for groundwater protection is provided as Appendix D. The Molokai Water Advisory Committee indicated in the February 2009 meeting that a protection program for the island was desired. Molokai fortunately has few current PCAs compared to more urban and developed areas. However, agriculture and residential development typically generate higher risk PCAs, such as septic systems and pesticide applications. A regulatory approach can prevent undesirable and high risk PCAs from being located within WHPAs, while non-regulatory approaches may best address existing PCAs, such as best management practices education and agreements.

Cesspools and septic systems

Installation of cesspools is no longer permitted in unsewered areas with the exception of the Hoolehua Hawaiian Homelands district. Should cesspools be identified within 1,000 ft of a drinking water well, an upgrade to septic tank would be required should a building permit be sought for the property. HAR 11-62 regulates individual wastewater system siting, distance from groundwater table, design and installation. All WHPAs are in established Critical Wastewater Disposal Areas (CWDAs) where the director of DOH may impose more stringent requirements for individual disposal systems. Septic tank effluent disposal systems must be located at least 1,000 feet from a drinking water well and at least 5 ft above groundwater table. Septic systems are allowed for new residential developments comprised of single-family dwelling units on a minimum lot size of 10,000 square feet, but hookup to sewer system is mandatory if available. Residential waste disposal systems are covered under UIC regulations if they serve a multiple dwelling, community or regional system. Maintenance of the private wastewater systems are not monitored or enforced.

Suggested Protection Strategy:

Maps of updated WHPAs should be provided to DOH Maui and Molokai district office with request to require minimum effluent discharge to the ground, such as evapotransipiration aerobic treatment in delineated areas. Development guidelines can set a recommended minimum density of 1 septic unit/2 acres for new development in WHPAs. All residential development in Molokai WHPAs are in unsewered areas. DWS should fund and provide in cooperation with DOH Wastewater Branch public education material to ensure proper maintenance and prevent use of improper septic tank cleaners.

Golf course

The Ironhills Golf Course extends into the 10 year WHPA of Kualapuu Well. Contaminants commonly associated with golf courses are nutrients applied to the soil, primarily Nitrogen (N), Phosphorus (P) and Potassium (K) and pesticides, including herbicides, insecticides and fungicides. Without proper management, these contaminants may leach into groundwater. In a survey of 37 golf courses in Hawaii, researchers identified 30 different pesticides in use (Brennan, B.M. et al. 1992. Estimated Pesticide Use on Golf Courses in Hawaii. No 137, Research Extension Series, University of Hawaii College of Tropical Agriculture and Human Resources).

Suggested Protection Strategy:

Golf courses is a medium risk PCA. The Draft Wellhead Protection Ordinance prohibits new golf courses in the 2-year time of travel zone. Within the 10 year time of travel zone golf courses are prohibited unless they meet performance standards outlined in the ordinance. The existing golf course should meet "Golf Course Management Measure" outlined in Hawaii's Coastal Nonpoint Pollution Control Program Management Plan. Appropriate BMPs include:

Nutrient management:

- Schedule fertilizer application so that the chance of leaching and run-off of soluble fertilizers is minimized

- Apply slow release fertilizers that will release nitrogen at a rate comparable to the rate at which it is used by the turf
- Apply slow release nitrogen fertilizer in an insoluble form. Calibrate fertilizer application equipment regularly.
- Calibrate fertilizer application equipment regularly.

Implement an integrated pest management (IPM) plan that includes, among other things:

- Emergency response procedures to be undertaken in the event of a spill or accident.
- Avoid applying pesticides in areas where there is a high potential for leaching.
- Avoid locating greens and tees that may require high amounts of pesticides within WHPAs
- Avoid applying pesticides near well heads.
- Apply pesticides when runoff losses are unlikely.
- Ensure proper storage of pesticides, located away from wellheads, and if possible from WHPAs.

Household hazardous products

Household chores involve a range of hazardous and non-hazardous products such as paints, solvents, synthetic detergents, pesticides, medicines, fuels, disinfectants, pool chemicals, oils, and batteries. These items can potentially enter groundwater sources when improperly stored through garage floor drains, spills and flooding, through disposal down household drains or through dumping and disposal on the ground. Pesticides, herbicides and fertilizers are sometimes over-applied on lawns and in flower and vegetable gardens and may infiltrate groundwater. Household hazardous products are exempt from hazardous waste and storage regulations.

Suggested Protection Strategy:

Public education for household practices should continue, including newspaper and radio advertisement, and public pollution prevention workshops. The potential contamination load would also be reduced with residential development density restrictions.

Pesticide application

There are no current large scale agricultural operations in WHPAs but pesticides are probably applied in small scale farming and home gardens. Applicators of registered pesticides must be licensed with DOA/EPA. The use of a pesticide can be cancelled, suspended, or restricted or limited to areas to protect groundwater.

Suggested Protection Strategy:

Public education and workshops in coordination with the University of Hawaii College of Tropical Agriculture and Human Resources (CTAHR) or other appropriate agency should teach Integrated Pest Management (IPM) practices. Application of pesticides and fumigants with high leachability should be avoided in the 2-year time of travel WHPAs or, where no alternative pesticide is available, applied as part of an IPM program.

Pesticide storage and disposal

No pesticide storage was located within WHPAs, but storage could occur with small scale farming in agricultural and residential areas. Pesticides are commonly stored in above ground storage tanks. Unregulated tanks may pose a risk of contamination if not properly maintained. Tanks containing less than 660 gallons of non-hazardous chemicals are not regulated. Larger storage must be labeled, and leak free containers and pesticides may not be disposed of except through regulated hazardous waste facilities. Pesticide wastes include leftover pesticides, unusable pesticides, pesticide containers, and rinse water Pesticide leftovers may not be accumulated by large quantity handler (>5000 kg/year) for more than one year. Empty containers must be triple rinsed and taken to landfill, or buried 1 ft deep in ground.

Suggested Protection Strategy:
For large farms, it may be possible to locate pesticide storage and mixing areas outside WHPAs in order to prevent leaks and spills. Where location outside critical areas is not feasible, best management practices including a secondary containment system should be required.

Well sites
Wells provide a pathway for contaminants associated with land uses around the well. Private well sites are not subject to the same monitoring requirements for contaminants or sanitary surveys as public system wells and are often surrounded by farming and other business activities. Permit and registration with the Commission on Water Resource Management (CWRM) is required for new wells. Groundwater quality is not addressed through standards conditions but on a case-by-case basis. Abandoned wells require casing, plug back, cap, or cement fill and seal well. There may be abandoned wells that are unaccounted for and present a conduit effect for contaminants to enter an aquifer. DWS will need assistance from CWRM and the community to actively search for abandoned unsealed wells.

Suggested Protection Strategy:
BMPs for private wells should be distributed to all well owners located through CWRM well database. CTAHR Water Quality Extension Program may arrange workshops that include well BMPs. As part of the source protection grant agreement with DOH, DWS will conduct island wide surveys of PCAs. The survey can be coordinated with CWRM to locate and report any abandoned wells.

Overlay Zoning Regulation
Several existing PCAs may individually and cumulatively pose considerate threats to the underlying water supply. The Maui advisory committee suggested considering density of PCAs rather than individual sources. Clusters of small-scale businesses such as auto body shops and services, whose practices are not regulated by federal or state laws, use significant quantities of hazardous materials such as solvents. Molokai fortunately has very few existing high risk PCAs on island, and no detected contaminants generally associated with PCAs. Although typical high risk PCAs are unlikely to locate in Molokai WHPAs in the future, prohibiting such future activities in WHPAs is recommended due to the nature of the activities, contaminants associated with them and past record of contamination elsewhere. Regulation by complete prohibition is consistent with most wellhead protection ordinances, regardless of site-specific history of contamination, to provide the greatest assurance that inadvertent discharge of pollutants into the groundwater supply will no occur. The prohibition list should represent changes in knowledge and technology so that as other polluting uses are discovered or as the employed technology reduces pollution potential, uses can be added or eliminated from the list.

There are currently no properties with business zoning within the WHPAs. However, rezoning to business would allow new establishments of automobile service businesses, printing shops, and other medium – to high risk uses, while light industrial zoned areas would potentially allow a range of high-risk uses. An overlay zoning district based on the delineated WHPAs could restrict uses that are incompatible with groundwater protection without changes to the underlying zoning districts. An overlay zoning ordinance would typically allow existing non-complying uses to continue operating, but subject to land use restrictions if any change in use is proposed. A Draft Wellhead Protection Ordinance for Maui County prepared in cooperation with the Maui Advisory Committee is attached in Appendix E. Regulatory and non-regulatory management approaches are illustrated in light of legal and administrative considerations in Appendix F.

Public Education
BMP education and compliance with applicable regulations in place should be further promoted. A risk of contamination from current PCAs can be the result of a lack of understanding of environmental hazards. On Maui, DWS has distributed targeted pollution prevention material through direct mailings

to businesses and residences, newspaper and radio advertising and workshops. A similar campaign to educate citizens about the link between their actions and the impact on water quality and should be implemented on Molokai. Even un-identified or unknown PCAs pose a potential threat. Accidents such as a truck spill have the ability to release large quantities of hazardous material on roads in the vicinity of a well.

Land use agreements:
Protective agreements could be worked-out with the private landowners, stipulating appropriate BMPs for PCAs on site. Any changes in land use need to be reported and would be subject to land use controls. Potential cooperation agreements include:

1. Utilities: Integrated Pest Management for vegetation/weed control
2. Public Works: Exclude high-risk herbicides in weed control of right-of-ways and highway roadsides in WHPAs.
3. Farmers: Agreement to avoid high-risk pesticides in WHPAs or critical recharge areas.

Land acquisition:
The Department should acquire the immediate land surrounding developed and future well sites. Immediate land area should at least include a protection area from vandalism, tampering and similar threats. Wells planned for immediate development should be encompassed by current land use control measures. It may not be feasible for the County to acquire enough land to completely protect the underlying water source, but in planning parks and open space, areas significant to groundwater protection should be considered.

Project district, mixed use & residential development design
While open land and low-intensity land uses are desirable in protection areas, these goals pose potential conflicts with current and proposed land and resource use. Residential uses generally pose a low risk to water quality, but may not be desirable in protection areas unless appropriate sewer systems and design standards to minimize contamination are provided. Nitrates are commonly associated with septic systems and lawn fertilizing. An increase in residential density also brings along increased road runoff and use of household hazardous products. New development design could incorporate groundwater protection in the WHPAs in several ways, such as locations of park and storm water detention areas, and residential densities. Low residential and commercial density in WHPAs is suggested to maintain groundwater recharge, prevent overloading of household hazardous products and septic systems and keep runoff basins outside WHPAs where feasible. Large-lot zoning is used to reduce the impacts from residential development by limiting number of units within WHPA. A minimum lot size of 2 acres for residential development has been reported to maintain compliance with nitrate standards (Stevens Point Whiting-Plover Wellhead Protection Program). On-site septic system density control should be provided at a minimum in the 2-year microbial contamination zone to prevent future contamination from viruses, bacteria and other contaminants typically associated with on-site septic systems. Only un-sewered development would be subject to the density restrictions.

The following design guidelines are suggested for all new commercial, residential or mixed use development projects, excluding residential subdivisions of 2 lots or less, throughout the WHPAs:

2-year time of travel WHPA:

- Commercial and high-density residential development should be minimized.
- Appropriate uses are open space, parks, schools and low density residential (minimum 2-acre lots)
- Projects should be designed such that more intense uses are as far as possible from the wellhead while areas closer to the wellhead are reserved for less intensive uses.
- Storm-water infiltration basins should be located outside the WHPA where feasible.

10-year time of travel WHPA:

- High risk commercial and high-density residential development should be minimized.

- Appropriate uses are open space, parks, schools, low risk commercial and low density residential (minimum 1-acre lots)
- Projects should be designed such that more intense uses are as far as possible from the wellhead while areas closer to the wellhead are reserved for less intensive uses.
- Storm-water infiltration basins should be located outside the WHPA where feasible.

2-year and 10-year time of travel WHPA:

- Proposed development entirely within the WHPA should be grouped and sited on the subject parcel at as far distance as possible from the wellhead.
- Where development is proposed on property extending both inside and outside the WHPA, and where sufficient buildable land area exists on the portion of the property outside the WHPA boundary to accommodate the proposed development, and where applicable setbacks permit, that area in its entirety should be utilized before any land within the WHPA should be used. Where insufficient buildable land area exists on the portion of the property outside the WHPA to accommodate the proposed development, as much of the development as possible should be sited outside the WHPA.
- Expansions of existing uses should at least conform to these guidelines where the use is expanding beyond its' property boundaries.
- Vegetative cover should be provided on all disturbed land areas, excluding fallow agricultural fields, not covered by paving, stone or other solid material. The maintenance or use of native plant materials with lower water and nutrient requirements is encouraged.

Well siting

Siting of new wells should be preceded by delineation of a WHPA around the well, identification of existing land use and contamination sources and consultation of development plans in the WHPA to identify the impact of future land use and any need for land use controls to protect the well.

PROGRAM IMPLEMENTATION

Legal Issues and Potential Conflicts

The Maui advisory committee questioned whether siting of new wells downgradient of private land could potentially reduce land value and utilization due to land use restrictions. This also raised the issue of takings. Restrictive government decisions may constitute a taking in cases where the regulation interferes with reasonable investments made prior to general notice of the regulatory program, where the regulation deprives the landowner of all, or substantially all economically viable uses for the property with no off-setting reciprocal benefits; or where the regulation abrogates an essential element of private property. A regulatory approach would need to consider existing uses and proposed projects under current zoning to ensure that no restrictions will constitute a taking of private property. If prohibiting certain land uses, there is a potential impact on businesses, farms and "the little guy". Comment has been made that many land owners are already conscientiously implementing BMPs and are concerned that costly additional restrictions would be set. Program elements should be negotiated carefully so as not to overburden existing users. However, the overall impact and the benefits to the community must be evaluated. The benefits of wellhead protection include reducing liability from leaks and spills, decreasing emergency response costs, a safe and viable water supply, avoiding costly treatment systems to treat contaminated drinking water, replacing wells due to contamination and remediation costs to remove the source of contamination.

Administration & Financing

Implementation of an overlay zoning ordinance should rely on existing administration and staff for processing zoning requests. Non-regulatory management, such as BMPs and land use agreements requires coordination between DWS and the agencies currently assigned to technical assistance and administration. Farming BMPs should be coordinated with the Natural Resource Conservation Service (NRCS); chemical use, handling and waste with the Department of Health offices and the

County Department of Environmental Management; and individual PCAs with the appropriate agency as defined in the Appendix E. If an ordinance stipulates mandatory performance standards in addition to existing state and federal requirements, coordination and inspection by the approving agency will be necessary. An overlay zoning ordinance would be enforced as other zoning by the Police Department.

Public participation

DWS has worked with stakeholders of the Maui community in developing a protection strategy. The Molokai Water Use and Development Plan Advisory Committee has provided input on the protection strategy and voiced support for an overlay zoning ordinance. The DWS needs to continue working with stakeholders on Molokai to develop and implement wellhead protection measures to carry out the objective stated in the Molokai Community Plan environmental policy, including continuing public education campaign and incentives for landowners to protect the island's ground water sources from contamination.